EXHIBIT 2

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

FRANKLIN BUONO, *Plaintiff,* v. POSEIDON AIR SYSTEMS, VICTORY AUTO STORE, INC., VICTORY AUTO STORES, INC. d/b/a POSEIDON AIR SYSTEMS, WORTHINGTON INDUSTRIES, INC., AND TYCO FIRE PRODUCTS LP, *Defendants.*	Civil Action No. 1:17-cv-05915 (PMH)
TYCO FIRE PRODUCTS LP, *Third-Party Plaintiff,* v. OPRANDY'S FIRE & SAFETY INC., *Third-Party Defendant.*	**DECLARATION OF BRAD A. JAMES**

I, Brad A. James, hereby declare as follows:

1. Exponent was retained by counsel for Tyco Fire Products, LP, to analyze the physical evidence and review pertinent documents related to the rupture of the fire suppression test tank that occurred on February 12, 2016, at Oprandy's Fire and Safety Equipment, Inc., in Middletown, New York.

2. In connection with Exponent's investigation, I provided a report entitled "Buono v. Poseidon Air Systems et al., Metallurgical Investigation" on April 16, 2020. A true and correct copy of my report is attached hereto as Exhibit A.

3. The contents of this report are true and correct to the best of my knowledge and belief.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Executed on this 1st day of February, 2021, at Redwood City, CA.

B A James

Brad A. James

EXHIBIT A

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

FRANKLIN BUONO, *Plaintiff,* v. POSEIDON AIR SYSTEMS, VICTORY AUTO STORE, INC., VICTORY AUTO STORES, INC. d/b/a POSEIDON AIR SYSTEMS, WORTHINGTON INDUSTRIES, INC., AND TYCO FIRE PRODUCTS LP, *Defendants.*	Civil Action No. 1:17-cv-05915 (NSR) (LMS) **EXPERT REPORT OF BRAD A. JAMES**
TYCO FIRE PRODUCTS LP, *Third-Party Plaintiff,* v. OPRANDY'S FIRE & SAFETY INC., *Third-Party Defendant.*	

Exponent Engineering, P.C.

Exponent®

Buono v. Tyco Fire Protection et al., Metallurgical Investigation

Exponent®

Buono v. Tyco Fire Protection et al., Metallurgical Investigation

Prepared for:
Williams and Connolly
725 Twelfth Street
Washington DC, 20005

Prepared by:

Brad James, Ph.D., P.E., FASM
Group Vice President and Principal Engineer
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April 16, 2020

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Contents

Scope

At the request of Williams & Connolly LLP, Exponent Engineering, P.C. (Exponent) has analyzed the physical evidence and reviewed pertinent documents associated with the Franklin Buono versus Tyco Fire Protection et al. case. The following report details the investigation, results, and my opinions.

A copy of my curricula vitae is included in Appendix A, which includes a list of publications and presentations as well as my educational background and selected project experience. A list of deposition and trial testimony from the past four years is included in Appendix B. Documents considered are listed in Appendix C. Exponent charges $585 per hour for my time in 2020.

Summary of Opinions

Based on our investigation, I have arrived at the opinions listed below. The bases for these opinions is contained in the subsequent sections of this report.

1. The February 12, 2016 accident at issue occurred because the subject cylinder was over pressurized.
2. The accident cylinder rupture preceded any of the other breaks or damage.
3. Fractographic analysis indicates that both the subject cylinder and associated fittings fractured by overload. No evidence of any progressive fracture mechanisms was observed.
4. There is no evidence that any manufacturing or material defect existed in the subject cylinder or contributed to the accident.
5. The subject cylinder rupture pressure exceeded 1300 psig.
6. An appropriate pressure-relief valve or other safety equipment would have prevented this accident.

Note that this Summary of Opinions does not contain all of Exponent's technical evaluations, analyses, conclusions, and recommendations. Hence, the main body of this report is at all times the controlling document.

Background

I have been retained by counsel for Tyco Fire Protection to examine the ruptured pressure cylinder and associated equipment at issue in the *Buono v. Tyco Fire Protection et al.* case

On February 12, 2016 at approximately 9 am, Franklin Buono and a coworker, Christopher Foust, were using compressed air from a high-pressure source to fill a smaller fire suppression cylinder. The smaller cylinder ruptured and caused significant injuries to both Mr. Buono and his coworker.

The source of the high-pressure compressed air was a Poseidon cascade system, which is designed for use in filling breathing-air tanks,[1] and was reportedly capable of providing pressure between 4000 and 5000 psi.[2] According to the Occupational Safety and Health Administration (OSHA) investigative report, Mr. Buono and coworker were using the regulator and a quarter-turn ball valve to control the pressure from the Poseidon system, and a regulator set to 450 psi during filling.[3] The cylinder that was being filled (and subsequently ruptured) was a fire suppression cylinder manufactured by Worthington Industries in August, 1998.[4] This cylinder was manufactured in accordance with DOT 4BW for pressures up to 225 psi.[5]

While filling, Mr. Buono and Mr. Foust stated that they could not determine whether air was going from the Poseidon system into the cylinder, because they could not hear the flow of air or see movement on the gauge. Mr. Foust allegedly used a screwdriver to press down on the assembly and after doing so several times, the cylinder exploded.[6]

I inspected the subject ruptured fire protection cylinder and associated components in Exponent's New York City office on April 16, 2018. At this inspection, I non-destructively examined the incident components visually and via optical microscopy to help determine the cause of the rupture. I have also reviewed OSHA reports describing the accident, OSHA's investigation, and their additional laboratory analyses performed by the OSHA Salt Lake Technical Center.

The opinions presented in this report are based on the materials I reviewed, my analysis of the subject cylinder, and my education, experience, and knowledge. I reserve the right to supplement this report and to expand or modify my opinions based on review of additional material as it becomes available through ongoing discovery, and/or through any additional work or review or additional work performed by others. Although I have not prepared any trial

[1] http://www.poseidonair.com/cascade/

[2] U.S. Department of Labor -OSHA Report: Inspection Number 1125359, Safety Narrative

[3] Ibid

[4] U.S. Department of Labor – OSHA Report, Inspection Number 1125359, Evaluation of Ruptured Fire Suppression Tank

[5] Ibid

[6] U.S. Department of Labor -OSHA Report: Inspection Number 1125359, Safety Narrative

exhibits at this time, I may do so, and I may use any and all of the information described or referenced in this report or in this case for such purposes or for demonstrative aid purposes.

Qualifications and Experience

I have been employed at Exponent Inc. for over 25 years and am currently a Group Vice President and Principal Engineer. I received my Ph.D. in Metallurgical and Materials Engineering from the Colorado School of Mines in 1994, where I studied metallurgy, materials science, fracture, fatigue, embrittlement, and corrosion. I also minored in Engineering Mechanics. Prior to graduate school, I worked as a Research Engineer at Babcock and Wilcox, where I conducted corrosion, fatigue, fracture, and failure analyses of various metals and materials. I received my undergraduate degree in Metallurgical Engineering from the University of Washington in 1988.

I specialize in failure analysis, failure prevention, and integrity assessment of engineering structures and components. My specific expertise includes metallurgy, materials science, fracture, fatigue, material degradation, corrosion, life prediction, and design. In my many years of engineering experience, I have conducted thousands of failure analysis/ engineering investigations on widely varying engineering structures, ranging from miniscule medical devices to large power-plant components. I also help clients from various industries prevent failures, assess the integrity of their designs or equipment, as well as interact with governmental agencies. The common thread in each of my investigations is the application of metallurgical, materials science, and engineering mechanics fundamentals to help understand and solve complex problems.

In addition to my work at Exponent, I have served as an Adjunct Professor at Stanford and Santa Clara Universities, teaching graduate-level failure analysis and fracture mechanics courses. I have also taught failure analysis courses to engineers through ASM International (formerly the American Society of Metals). In 2011, I was elected as a Fellow of ASM International.

My curriculum vitae, which includes a list of the publications I have authored, is attached as Appendix A, and a list of my trial and deposition testimony for the last four years is attached as Appendix B. The documents I have considered for this investigation are listed in Appendix C. Exponent Inc. charges $585 per hour for my time. My compensation is not affected by the outcome of this matter. The following report describes my findings, opinions, and the bases for my opinions. In the event that any additional relevant information is made available to me, I reserve the right to amend my report and my opinions accordingly. I reserve any other right I might have to supplement or amend my opinions. If asked, I will be prepared to provide a tutorial on the background concepts that underlie this report. I may use demonstrative exhibits in connection with my testimony, and reserve any right I have to do so.

Analysis

The OSHA Salt Lake Technical Center (SLTC) conducted a metallurgical analysis the subject cylinder and associated components, and issued a report that detailed their findings on May 5, 2016. The OSHA SLTC inspection included optical microscopy, scanning electron microscopy (SEM), and hardness testing.

Exponent conducted a visual inspection of the ruptured cylinder and associated components on April 16, 2018. The evidence available for our inspection included the ruptured cylinder fragments, samples excised by OSHA SLTC (as part of their investigation), and associated components, as shown in Figure 1.

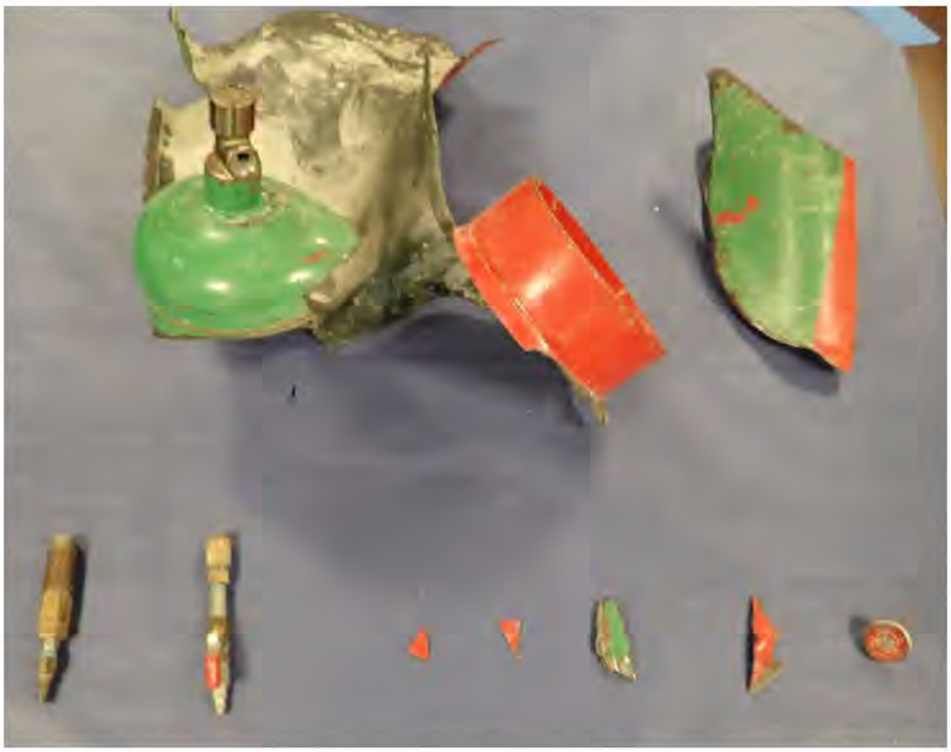

Figure 1. A photograph showing various pieces of the subject ruptured cylinder and associated components

As part of the rupture event, the subject cylinder was separated into two fragments (as shown in Figure 1 of the May 5, 2016 OSHA report). Subsequent testing by OSHA included cutting small samples for fractographic analysis and hardness testing. Markings present on the top of the subject cylinder cap were: “WORTHJ 08-98”, “26553AD”, and “DOT 4BW 225 M4543”, as shown in Figure 2 through Figure 4. These markings indicate that the cylinder was manufactured by Worthington Industries in August 1998, that the cylinder was manufactured in accordance with DOT 4BW, and rated for pressures up to 225 psi. The cylinder wall thickness

measured between approximately 0.073 and 0.084 inches, depending on the location of measurement. The cylinder diameter was approximately eight inches.

Figure 2. A photograph of the subject cylinder showing the markings "WORTH J 08-98"

Figure 3. A photograph of the subject cylinder showing the markings "26553AD"

Figure 4. A photograph of the subject cylinder showing the markings "DOT 4BW 225 M4543"

Subject Cylinder

The cylinder rupture primarily occurred along its longitudinal axis (shown in Figure 1), consistent with stress from internal pressure. The fracture path deviated from the longitudinal axis at both the top and bottom caps, and generally acted to flatten the subject cylinder, also consistent with stresses from internal pressure. The fracture surfaces present on the subject cylinder were oriented approximately 45° with respect to the wall thickness, consistent with ductile shear morphology. Fractographic analysis showed no evidence of progressive crack growth, such as fatigue or stress corrosion cracking, or any sort of manufacturing or welding defects or anomalies. Scanning electron microscopy (SEM) as performed by SLTC, showed that the subject cylinder rupture surfaces exhibited microvoid coalescence fracture morphology (Figure 5), which confirmed ductile overload fracture. These observations indicate that the accident cylinder fractured in a ductile manner as the result of a single over-pressurization event.

The top cylinder cap was deformed inward at the location at the base of the valve assembly, as shown in Figure 6. This deformation is consistent with an outside force acting in an inward direction at the valve/ pipe fitting assembly. This force was likely the result of the valve/fitting assembly impacting another hard object after the initial overpressure-induced failure. The fractured fitting is discussed in the following section.

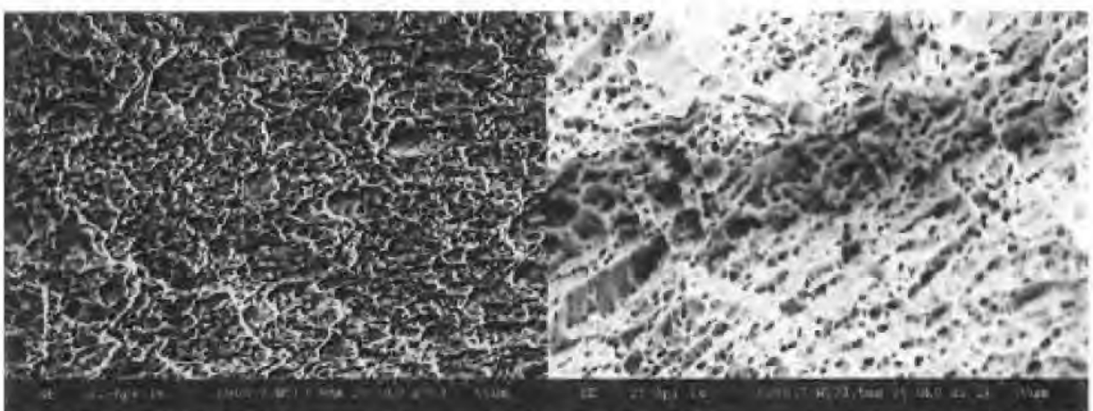

Figure 12: Examples of SEM image of fracture surface from samples cut from ruptured tank showing ductile failure.

Figure 5. SEM image (taken by SLTC) showing microvoid coalescence on the fracture surface of the ruptured cylinder.

Figure 6. A photograph of the valve/fitting assembly and cylinder cap. Inward deformation of the cylinder cap (circled) was caused by external loading applied to the valve/fitting assembly.

Subject Pipe Fitting

The subject fitting assembly was originally connected to the subject cylinder valve assembly, and is shown in Figure 7. The fitting assembly consisted of two components: a pipe nipple that connected to the accident cylinder valve assembly, and a quarter-turn ball valve component, that connected to the nipple via a brass, quick connect-type pressure fitting. The threaded nipple was threaded into the valve assembly, and fractured at the first non-engaged thread. The location of the fractured threaded end is indicated by an arrow in Figure 7. Photographs of the pipe fitting fracture surface and the remaining, mating fracture surface within the valve assembly are shown in Figure 8.

Figure 7. Photographs of the subject fitting assembly. The arrow indicates the threaded nipple fracture surface.

Figure 8. Photographs of the fracture surfaces on the pipe nipple (left) and the mating surface still contained in the cylinder valve assembly (right). The thread "step" is indicated by and arrow in both images.

Both mating threaded pipe nipple fracture surfaces exhibit a matching "step" where the fitting fracture surface is separated by a thread step, as shown by arrows in Figure 8. Due to geometry, when fractures occur in the threaded portion of fasteners/connections, a "step" or skipped thread is typically formed at the final fracture location. Thus, the area opposite the skipped thread is typically near the fracture origin.

As observed in the right-hand image of Figure 8, the skipped thread is present at approximately the 4 o'clock position in the connection to the valve assembly. This indicates that the fracture origin was located at the top half of the valve/fitting assembly, and the final fracture location at the bottom half. This fracture morphology is consistent with the fitting being "bent" downwards direction (as shown in Figure 8). For a bending moment to occur at this location, a force must have been applied to the pipe fitting in approximately the downward direction (toward the center of the cylinder). Loading in this direction is consistent with the inward plastic deformation observed on the cylinder cap itself. This loading condition is schematically depicted in Figure 9.

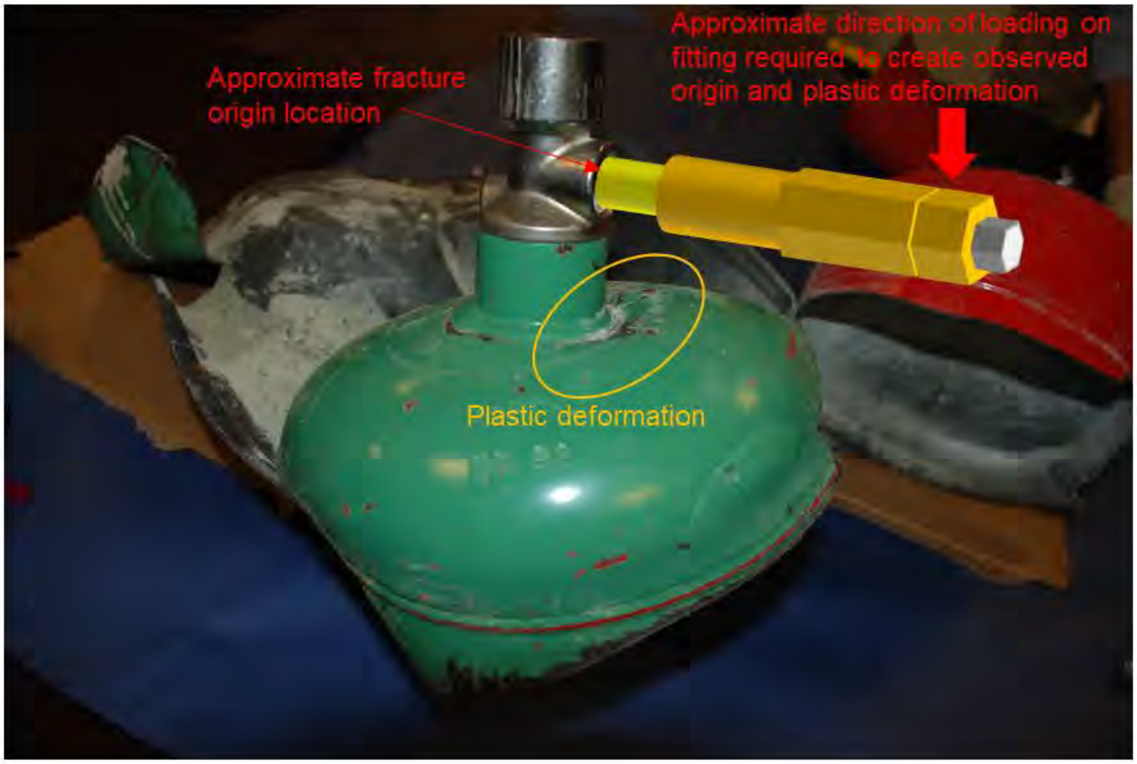

Figure 9. A diagram of the loading condition/direction that caused the pipe nipple to fracture within the threaded region, with the pipe fitting prior to fracture schematically depicted. Both the fracture initiation location within the threaded region, and the gross plastic deformation observed on the cylinder are consistent with a load being applied downward on the pipe fitting. Note: schematic of fitting is not to scale but enlarged to illustrate approximate loading direction.

OSHA SLTC conducted an SEM-based fractographic examination of the subject threaded nipple fracture. SEM images presented in the SLTC report are shown in Figure 10. While the copies of the SLTC images are relatively poor, they do indicate cleavage fracture morphology, consistent with a break caused by a single, high strain-rate (impact) event. No evidence of a progressive fracture mechanism, such as fatigue or stress corrosion cracking was observed at the threaded pipe fitting fracture site. Further, no evidence of any manufacturing defect or anomaly was observed.

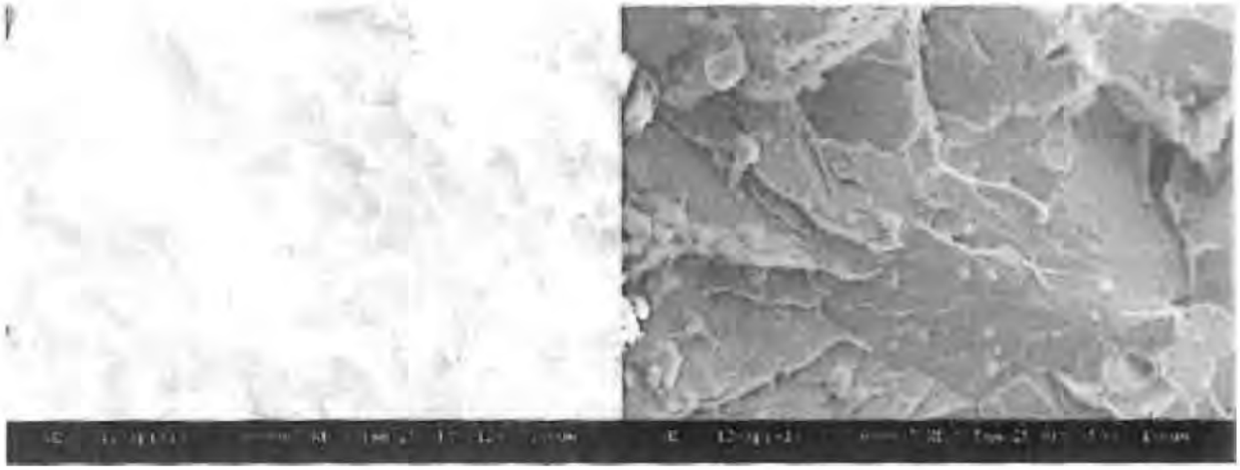

Figure 10 OSHA SLTC images of the subject threaded pipe nipple fracture surface. The SEM images indicate cleavage fracture morphology, indicative of brittle overload fracture.

The macroscopic and microscopic fracture surface features observed on the threaded pipe fitting, as well as the inward plastic deformation of the top of the tank are consistent with the following sequence of events: (1) primary rupture of subject cylinder due to over-pressurization; and (2), forceful impact of the subject valve/ pipe fitting assembly with an external object (i.e., upon tank rupture, the valve/pipe fitting assembly were launched through the air, ultimately colliding with a hard object). Thus, the pipe fitting fracture and damage to the top of the tank are the "victims" of the tank rupture.

Maximum Burst Pressure

For the given cylinder dimensions (where wall thickness is less than 10% of the radius) the tank can be approximated as a thin-wall pressure vessel.[7] SLTC conducted hardness testing of the subject tank. Although the SLTC Rockwell C hardness values were less than the minimum (20) on the Rockwell C hardness scale, SLTC approximated the subject cylinder tensile strength to be between approximately 88 and 96 ksi.[8]

The hoop stress for a thin-walled pressure vessel can be calculated using the formula:[9]

$$\sigma = \frac{Pr}{t}$$

[7] R. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*. 4th Edition, 1995

[8] U.S. Department of Labor – OSHA Report, Inspection Number 1125359, Evaluation of Ruptured Fire Suppression Tank

[9] R. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*. 4th Edition, 1995

where P is the internal pressure, t is the wall thickness, and σ is the hoop stress. Rearranging the above equation to solve for P yields:

$$P = \frac{\sigma t}{r}$$

The stress at rupture will be the approximate tensile strength of the material (OSHA's minimum 88 ksi). Substituting the 88 ksi tensile strength for σ, roughly 0.06 inches for t, and a radius (r) of 4 inches, yields an estimated cylinder burst pressure of roughly 1,300 psig: more than five times the subject cylinder pressure rating of 225 psig.

Given the gross over-pressurization that was required to cause the cylinder rupture, a suitable, functioning pressure relief valve or an appropriate gas pressure regulator would have prevented over pressurizing the subject tank. Had a functioning pressure relief valve been appropriately placed and set, the subject cylinder would have vented when the internal pressure became too high. This venting would have relieved the internal pressure inside the cylinder and thus prevented the rupture caused by over-pressurization. A properly set regulator would have limited the pressure that could have been applied to the cylinder. Additional safety equipment (such as a safety cage) could have contained any fractured fragments in the event of an unanticipated rupture. The cylinder rupture was a high-energy release event. The result of this event is the sudden and rapid acceleration of fractured pieces of metal. Had the cylinder been contained in a safety cage, any shrapnel-induced injuries could have been prevented.

Limitations

At the request of Williams and Connolly, Exponent, Engineering Inc. (Exponent) has conducted a metallurgical analysis and reviewed pertinent case documents in the Buono v. Tyco Fire Products et al. matter. The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any reuse of this report or its findings, conclusions, or recommendations presented herein is at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation.

The findings presented herein are made to a reasonable degree of engineering certainty. We have made every effort to accurately and completely investigate all areas of concern identified during our investigation. If new data become available or there are perceived omissions or misstatements in this report regarding any aspect of those conditions, we ask that they be brought to our attention as soon as possible so we have the opportunity to fully address them.

Appendix A

Curriculum Vitae of Dr. Brad A. James

Exponent®
Engineering & Scientific Consulting

Brad A. James, Ph.D., P.E., FASM

Group Vice President & Principal Engineer | Materials & Corrosion Engineering
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Professional Profile

Dr. James specializes in failure analysis, failure prevention, and integrity assessment of engineering structures and components. His specific expertise includes metallurgy, materials science, fracture, fatigue, material degradation, corrosion, life prediction, and design.

In his many years of engineering experience, Dr. James has conducted thousands of failure analysis investigations on widely varying engineering structures, ranging from miniscule medical devices to power-plant components. Dr. James also helps clients from various industries prevent failures, assess the integrity of their designs or equipment, as well as interact with governmental agencies. Dr. James has special interest in fractography, fracture mechanics, wear, corrosion, embrittlement phenomena, microstructural development, heat treatment, material selection, and welding and joining. The common thread in each of Dr. James' investigations is the application of metallurgical, materials science, and engineering mechanics fundamentals to help understand and solve complex problems.

Dr. James has taught several graduate-level fracture mechanics and failure analysis courses at Stanford and Santa Clara Universities. He has also taught several courses for The American Society for Materials (ASM International) involving failure analysis, design, and life prediction/validation of medical devices, and has been a Visiting Lecturer at San Jose State University. Prior to joining Exponent, Dr. James was employed as a Research Engineer, Materials Performance Division, at the Babcock and Wilcox R&D Center.

Academic Credentials & Professional Honors

Ph.D., Metallurgical and Materials Engineering, Colorado School of Mines, 1994

B.S., Metallurgical Engineering, University of Washington, 1988

ASM International Fellow, 2011

Licenses and Certifications

Licensed Professional Engineer, California, #MT1867

Licensed Professional Engineer, Texas, #116334

FAA Private Pilot (Airplane Single Engine Land, Instrument Airplane)

Professional Affiliations

ASM International (Fellow)

International Organization on Shape Memory and Superelastic Technologies (member)

Independent Metallurgical Engineering Consultants of California (member)

Publications

Birringer R, Ganot G, James B. Failure analysis of internal fixation medical devices: overview and case studies, Journal of Failure Analysis and Prevention, Vol. 16, Issue 5, Oct 2016, pp 849-857.

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Proceedings, International Conference on Shape Memory and Superelastic Technologies, ASM International, pp. 117-124, Baden Baden, Germany, October 2004.

James B, Murray S, Saint S. Fracture characterization in nitinol. Proceedings, International Conference on Shape Memory and Superelastic Technologies, SMST Society, pp. 321-329, May 2003.

James B, Matlock D, Krauss G. Interactive effects of phosphorus and tin on carbide evolution and fatigue properties of 5160 Steel. 38th Mechanical Working and Steel Processing Conference, Vol. XXXIV, pp. 579-590, October 1996.

Jones D, Hoppe R, Hechmer J, James B. An experimental study on the effects of compressive stress on the fatigue crack growth of low-alloy steel. Journal of Pressure Vessel Technology 1994; 116:317-324.

James B. Interactive effects of phosphorus and tin on carbide evolution and fatigue and fracture properties in 5160 steel. Ph.D. Thesis, Colorado School of Mines, 1994.

Merlano N, James B, Matlock D, Krauss G. Effects of tempering and residual element content on mechanical properties of 5160H steel. Proceedings, Gilbert R. Speich Symposium, Iron and Steel Society, pp. 101-109, Montreal, Canada, October 1992.

James B, Paul L, Miglin M. Low cycle fatigue crack initiation in SA-210 A1 carbon steel boiler tubing in contaminated boiler water. Proceedings, Pressure Vessels and Piping Conference, ASME-PVP Vol. 195, pp. 13-19, Nashville, TN, June 1990.

Presentations, Seminars, and Published Abstracts

James B, Stevenson K, Bowers M, The metallurgy of fire cause-and-origin analysis, Materials Science and Technology Conference, Columbus OH, October 18, 2018.

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Birringer R., Hudgins A, James B, Case Study of a Natural Pipeline Explosion Caused by a Combination of Manufacturing Defects and Environmental Factors, Materials Science and Technology Conference, Salt Lake City, UT, October 24, 2016.

James B, Hudgins A, Fracture mechanics and crack management for natural gas operators, American Gas Association Fall Operators Meeting, Nashville TN, September 13, 2016.

James B, Briant P, Fatigue Design and Validation for Medical Device: What We Learned from Portico. Invited Lecture, St. Jude Medical Materials Summit, September 29, 2015.

Briant P, James B, Easley S, Kennett S, Schaffer J, Kay L, The effect of crimp strain on the fatigue performance of nitinol, Shape Memory and Superelastic Transformation (SMST) Conference. May 22, 2015.

James B, Briant P. Fatigue design and validation for medical devices: What we learned from Portico. Invited Lecture, St. Jude Medical Materials Summit, September 29, 2015.

Briant P, James B, Easley S, Kennett S, Schaffer J, Kay L. The effect of crimp strain on the fatigue performance of nitinol. Shape Memory and Superelastic Transformation (SMST) Conference, May 22, 2015.

James B. Medical device failure prevention and analysis. San Jose State University, March 6, 2014.

James B. Surgical tools failure analysis: Causes and prevention. Materials Science and Technology Conference, Montreal, Canada, November 2013.

James B. Medical device failure analysis. Fort Wayne Metals, IN, September 2013.

James B. Medical device design and failure analysis, ASM International, Materials Park, OH, November 2012.

James B. Pipeline rupture failure mechanisms and prevention. IMECA, Pacific Grove, CA, October 2012.

James B. Pipeline ruptures: Review of common metallurgical failure mechanisms. Materials Science and Technology Conference, Pittsburgh, PA, October 2012.

James B. Pipeline ruptures: Causes and prevention. Natural Gas Claims and Litigation Association, San Diego, CA, April 2012.

James B. Fracture, fatigue, corrosion and failure analysis of medical devices. Health Canada, Ottawa, Canada, March 2012.

James B. Medical device failure modes: Learning from unexpected outcomes. Plenary Speaker, Bay Area Biomedical Device Conference, San Jose State University, March 2012.

James B. Failure analysis for medical device engineers, ASM MPMD lecture, Medtronic, Minneapolis, MN, January 2012.

James B. Fracture fatigue and corrosion for medical device engineers, ASM MPMD lecture, Medtronic, Minneapolis, MN, January 2012.

James B. Nitinol processing, properties and design, ASM MPMD lecture, Medtronic, Minneapolis, MN, January 2012.

James B. Nitinol processing, properties and design. ASM MPMD lecture, Medtronic Vascular, Galway, Ireland, December 2010.

James B. Fracture, fatigue and corrosion for medical device engineers. ASM MPMD lecture, Medtronic Vascular, Galway, Ireland, December 2010.

James B. Failure analysis for medical device engineers. ASM MPMD lecture, Medtronic Vascular, Galway Ireland, December 2010.

James B. Fracture surface interpretation. Invited lecture, St. Jude Medical Cardiac Rhythm Management Division, Sylmar, CA, September 2010.

James B. Medical device fatigue design. Invited lecture, Medtronic Cardiovascular Innovation Seminar (CVIS), Santa Rosa, CA, July 2010.

James B. Fatigue design and validation of implantable medical devices. Invited lecture, St. Jude Medical, Cardiovascular Division, Maple Grove, MN, January 2010.

James B. Ultrasonic cleaning-induced failures in medical devices. Materials and Processes for Medical Devices, ASM International, Minneapolis MN, August 2009.

James B. Fatigue design and validation of implantable medical devices. Invited lecture, United States Food and Drug Administration (USFDA) Office of Science and Engineering Laboratories (OSEL) Science Seminar, June 2009.

James B. Medical device failures — Lessons learned. Invited lecture, Bio2Device Group, Sunnyvale, CA, March 2009.

James B. Medical device design validation and failure analysis. Materials and Processes for Medical Devices, ASM International Educational Course, 2008-present.

James B. Medical device failure analysis — Practice and pitfalls. Invited lecture, ASM International, Materials and Processes for Medical Devices Conference, Cleveland Clinic, August 2008.

James B. Medical device failure analysis. Invited lecture, San Jose State University, April 2008.

James B. Failure analysis for the medical device engineer. Materials and Processes for Medical Devices, ASM International Educational Course, 2005-2007.

James B. Fracture, fatigue and corrosion for the medical device engineer. Materials and Processes for Medical Devices, ASM International Educational Course, 2005-2007.

James B. Engineering design for medical device fracture, fatigue and corrosion performance. ASM International, Materials and Processes for Medical Devices Conference, Cleveland Clinic, October 2006.

James B. Medical device failure analysis. Invited lecture, San Jose State University, July 2006.

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James B. Compressive damage-induced cracking in nitinol. International Conference on Shape Memory and Superelastic Technologies, ASM International, Baden Baden, Germany, October 2004.

James B. Failure analysis of NiTi wires used in medical applications. Materials and Processes for Medical Devices, ASM International, St. Paul, MN, August 2004.

James B. Metallurgical failure analysis. Invited lecture, Stanford University, April, 2004.

James B. Fracture characterization in nitinol. International Conference on Shape Memory and Superelastic Technologies, SMST Society, May 2003.

James B. Interactive effects of phosphorus and tin on carbide evolution and fatigue properties of 5160 Steel. 38th Mechanical Working and Steel Processing Conference, Cleveland OH, October 1996.

James B. Effects of tempering and residual element content on mechanical properties of 5160H steel. Gilbert R. Speich Symposium, Iron and Steel Society, Montreal, Canada, October 1992.

James B. Low cycle fatigue crack initiation in SA-210 A1 carbon steel boiler tubing in contaminated boiler water. Pressure Vessels and Piping Conference, ASME, Nashville, TN, June 1990.

Book Chapters

James B, Hudgins A. Failure Analysis of Oil and Gas Transmission Lines. Handbook of Materials Failure

Analysis With Case Studies from the Oil and Gas Industry. Elsevier, 2015

James B. Medical Device Failure Analysis. ASM Handbook, Volume 23, Materials for Medical Devices, ASM International 2012.

Project Experience

Medical Devices

Dr. James has conducted hundreds of medical device failure analysis investigations. He has also assisted dozens of device manufacturers assess and validate fatigue and corrosion performance of their implants and surgical tools. Selected examples are as follows:

- Cardiovascular implants: Has conducted failure analysis investigations of dozens of stents, filters, and coronary/peripheral devices. Also has directed several fatigue, corrosion, and/or fretting studies of cardiovascular implants for various medical device manufacturers.
- Pacemakers / ICDs: Has conducted several pacemaker/ ICD failure analysis investigations. Dr. James has also helped pacemaker manufacturers with lead material selection, as well as fatigue and corrosion testing and validation.
- Orthopedic implants: Dr. James has conducted failure analysis investigations on dozens of orthopedic implants, including hip and knee prostheses, pedicle screws, bone plates, nails, and various other joint prostheses. He has also evaluated metallurgical, embrittlement, fatigue, coating, and corrosion issues to help manufacturers solve problems or validate device performance.
- Heart Valves: Has investigated several heart valve failures, and has extensive experience conducting and reviewing fatigue testing programs to help validate heart valve fatigue performance.
- Catheters: Has helped manufacturers design and develop catheters, as well as validate fatigue performance and investigate failures.
- Surgical tools: Dr. James has conducted several failure analysis investigations of surgical tools that have fractured or failed during service. He has also helped manufacturers conduct surgical tool fracture, fatigue, corrosion, and embrittlement studies.
- Needles: Has conducted failure analyses to determine the cause of needle breaks, as well as examined the effect of manufacturing processes on needle sharpness.
- Neuro-implants: Has conducted failure analysis investigations of neuro-vascular implants, as well as helped manufacturers validate neuro-vascular device fatigue performance.
- Diabetes/insulin monitoring devices: Has conducted failure analyses of insulin monitoring devices, as well as assisted manufacturers with coating and electrode development.
- Obesity devices: Dr. James has helped manufacturers develop and test various obesity devices.
- Ventricular-assist devices: Has conducted failure analysis investigations, fatigue performance validation, and material selection of ventricular-assist devices.
- Corrosion testing: Experience with potentiodynamic, open-current leaching, galvanic, and fretting testing to assess expected implant corrosion performance.

Pipelines

Dr. James has conducted dozens of failure analysis investigations of liquid and gas transmission pipelines and components. Dr. James has also helped assess the fitness for service and flaw tolerance of pipelines and associated components. The following list a few examples of his pipeline work.

- Hydrotest failure analyses: Dr. James has conducted failure analysis investigations to determine the cause of gas pipelines that ruptured during hydrotesting.
- Sierra-Nevada Pipeline Leak: Analyzed a pipeline leak in the Sierra-Nevada mountains that occurred due to damage from improper installation that occurred some 50-years prior to the leak. The local damage resulted in increased stresses that initiated slow-growing "near-neutral" stress-corrosion cracking.
- LEFM-fatigue analysis: Assessed the risk of fatigue-crack growth, leakage, and rupture in pipelines with

seam-weld defects of varying depths and lengths using linear-elastic fracture mechanics. This work provided the basis for the client to establish a methodology for seam-weld defect assessment.
- Estuary pipeline rupture: Investigated the cause of a pipeline rupture that occurred within an estuary. Evaluated the cause and extent of corrosion that led to the rupture.
- High pH SCC rupture: Evaluated the cause of a gasoline pipeline rupture that occurred in a high-population area in Arizona. The cause of the rupture was high-pH stress-corrosion cracking (SCC). Dr. James recommended hydrotesting of adjacent pipeline areas, which revealed other SCC locations that were close to rupture.
- Nevada 3rd party damage: Conducted a failure analysis investigation of a gasoline pipeline that leaked in the desert outside of Las Vegas. This pipeline had suffered a gouge from third-party digging. A fatigue crack initiated from the gouge and eventually grew through wall to cause a leak.
- Bellingham Washington pipeline: Helped investigate the cause of a ruptured gasoline pipeline rupture that tragically killed three youths. Dr. James participated in investigations at the NTSB and Exponent laboratories. The pipeline failed several years after it had been severely damaged by an excavator.
- Seam weld defect- Sacramento: Investigated the cause of a gasoline pipeline leak that occurred along an electric-resistance weld (ERW) seam near Sacramento, CA. The leak was caused by fatigue crack growth that initiated and grew from the seam weld defect.
- Seam weld defect - Texas: Investigated the cause of a gasoline pipeline rupture that occurred in Texas. Metallurgical examination indicated the rupture occurred at an improperly welded ERW seam. A fatigue crack initiated and grew in the weld seam until it reached sufficient length to cause the rupture.
- Australian Gas Pipeline SCC risk assessment: Participated in a study to assess the risk of rupture in an Australian natural gas pipeline that exhibited significant stress corrosion cracking (SCC). This analysis included using the results of in-line inspection coupled with fracture mechanics to help determine the risk of rupture.
- Attachment vibration-induced fatigue: Participated in a root-cause failure analysis investigation to help determine why several pump-station attachment piping fractured in a newly commissioned gas pipeline. The analysis confirmed that significant choked-flow conditions resulted in harmonic vibration-induced fatigue in attachment piping.

Food/Chemical Processing

Dr. James has conducted several failure analysis investigations of various food and chemical processing industry components. A representative list is shown below.

- Process piping weld specifications: Helped a food-processing plant revise their weld specification, testing, and validation procedures to eliminate leaks and stress-corrosion cracking of their 316L jacketed piping.
- Food processing piping failures: Examined the cause of leaks, fractures, and ruptures of piping and associated equipment in food processing plants. These failures have been caused by poor welding, vibration-induced fatigue, and stress-corrosion cracking.
- Ammonia refrigeration piping failures: Examined and determined the cause of failures in ammonia refrigeration units for ice cream and fruit processing plants. These failures have been caused by insufficient supports, vibration, and poor welds.
- Chemical processing valve: Determined the cause of failure of a large gate valve at a chemical processing plant. A combination of insufficient bolt torque and vibration resulted in insufficient bolt clamping force, which resulted in fatigue failure.
- Piping creep: Inspection of piping at a chemical processing plant revealed local bulging of adjacent piping. The cause of the failure was creep-rupture from excessive temperatures, and that the higher than desired temperatures occurred because of deposits that restricted cooling.
- Valve bolt failures: Bolts at a gasoline processing facility fractured causing a large loss. Analysis indicated that the bolts fractured due to stress-corrosion cracking. Material and environmental changes were recommended to eliminate the problem.
- Tee failure: A tee at an oil refinery ruptured resulting in release of product and environmental damage. Metallurgical analysis indicated that the tee failed due to a creep-rupture mechanism, caused by excessive temperature.

- Ethanol storage tank weld: An ethanol storage tank fractured at a weld, resulting in significant loss of product and damages. Analysis indicated that the tank fractured from stress-corrosion cracking at the weld heat-affected zone.
- Gasoline storage tank failure analysis and integrity assessment: Analyzed the cause of a gasoline tank failure, and conducted a fracture mechanics-based fitness for service analysis for floor-to-shell repair welds.

Fire Cause-and-Origin and Electrical Damage

Dr. James has conducted dozens of metallurgical and materials analyses of components involved or implicated as the cause of a fire. His analyses often involve assessing and differentiating the presence of arc-induced damage, melting-induced alloying, high-temperature damage, and creep associated with fires or electrical damage. Listed below are selected cases.

- Wildfire analysis: Dr. James has investigated several electrical distribution components implicated as the cause or contributors to wildfires.
- Crude oil pipeline leak: analyzed and confirmed that a major crude oil leak was caused by arcing associated with an adjacent electrical sub-station.
- PTCRs: Evaluated positive temperature coefficient resistors (PTCRs) as potential sources of arcing and fires in compressor motors.
- Service boxes: Analyzed whether service box damage indicated the cause and origin of fires, or damage associated with fires that initiated elsewhere.

Structural

Besides piping and other infrastructure analyses, Dr. James has conducted metallurgical failure analysis investigations on many structural components, including several scaffolding and crane failures. Listed below is a sampling of Dr. James' metallurgical analyses of engineering structure

- Boiler failure analysis: Dr. James has examined tube and header cracking and corrosion issues in several different boilers.
- Electrical tower collapse: Investigation of pre-existing cracks in an electrical line tower collapse, including the effects of potential strain aging and hydrogen embrittlement of the tower steel.
- Olympic stadium bolt failure: Examined the cause of bolt failures that occurred during construction of the Salt Lake City Olympic stadium.
- Swing scaffolding: A scaffolding supporting workers on the side of a building in Sacramento fractured, resulting in significant injuries. Metallurgical analysis, including fractography, metallography, fracture toughness, and tensile testing indicated the cause of the failure was overload.
- Paint Scaffolding: A hoist connection of a swing scaffolding fractured in San Francisco, resulting in significant injuries to one of the workers. Failure analysis indicated the hoist connection suffered bending-induced fatigue crack initiation and growth due to scaffold misuse.
- Bay Bridge scaffolding: Portions of an aluminum scaffolding used for painting the San Francisco/ Oakland Bay Bridge fractured, resulting in a worker's death. Metallurgical analysis, including fractography, metallography, and mechanical property testing, in combination with weld and structural analysis was used to determine the cause of the failure.
- Las Vegas sign welds: Analyzed welds that fractured in a high-rise sign during a windstorm to determine whether proper welding procedures were followed.
- Cranes: Dr. James has conducted several crane failures. These analyses have included root-cause assessment of wire rope, axle, rail, lug, and attachment cracking and fractures.

Fire Protection

Dr. James has extensive experience conducting failure analysis investigations of fire protection components. These analyses include determining the cause of many unintended sprinkler activations, as well as analysis of sprinkler piping leaks and ruptures. Selected examples of Dr. James' fire protection analyses are listed below:

- Fire sprinkler: Dr. James has conducted many failure analyses of fire protection sprinklers that either activated in the absence of a fire or did not activate as designed. These have included many fusible-link solder as well as glass-bulb sprinkler designs.
- Sprinkler pipe weld-o-let leaks: Examined the cause of sprinkler pipe weld-o-let leaks in a large government building. Assessed the leaks and the likelihood that any additional could occur after hydrotesting.
- Sprinkler Pipe: Dr. James has conducted several analyses of fire-protection sprinkler piping that ruptured or leaked. Causes of the failures have been ranged pitting (and possible microbial-influenced corrosion), grooving corrosion, improper roll-grooving, and freezing.
- Corrugated stainless steel piping: Investigated the cause of leakage in a corrugated welded stainless steel sprinkler piping. Fractographic and metallographic examination indicated sensitization and stress corrosion cracking.
- Fitting fracture: Dr. James had examined several fire sprinkler-system fitting fractures to determine the cause of failure.

Aerospace and Motor Vehicle

Dr. James has conducted several aerospace and motor vehicle failure analysis investigations. These investigations typically involve metallurgical and mechanical analyses to examine the cause of a component failure, or to assess the integrity or expected lifetime of a specific component.

- Lead investigator of a US Air Force-funded study to assess long-term cracking mechanisms in titanium and aluminum-alloy fuel and storage tanks.
- Crimped aluminum microcracks: Assessed whether microcracks present in crimped aluminum rocket components would be expected to propagate or decrease functionality in rocket-body housings.
- Cut copper conductors: Helped predict the remaining life of stranded copper conductors that had been cut during the fabrication of a satellite using both stress-life and fatigue-crack growth methodologies.
- Ultrasonic weld fatigue: Conducted analysis and testing to predict the fatigue performance of ultrasonically welded components in satellite applications.
- Airplane propeller shaft: Conducted a root-cause failure investigation of a propeller shaft that fractured in service. The subject shaft fractured due to unidirectional torsional fatigue.
- Steering knuckle investigation: A rash of steering knuckle failures was observed in specific sport utility vehicle. Dr. James conducted a metallurgical investigation into the cause of the failures and presented the results to NTSA on behalf of the client.
- Engine Mount: Determined whether a broken engine mount could have contributed to a vehicle crash. Analysis confirmed the mount fractured by overload, and therefore was broken during the crash, rather than causing it.
- Spot weld analyses: Dr. James has participated in several analyses to examine fractured spot welds following vehicle accidents. These analyses assess spot weld size and failure mode.
- Steering system failure analysis: Dr. James has investigated several steering system failures, including projection weld fractures and bellows cracking.
- Motorcycle gas tank ejection: Examined fasteners associated with the gas tank ejection following a motor cycle accident. Conducted testing to determine the amount of thread engagement necessary to recreate the accident bolt features as well as to retain the tank in an accident.
- Chopper weld failure analysis: Conducted a failure analysis investigation of broken welds in a custom chopper to assess failure mode and any welding issues.
- Wheel-off: Dr. James has conducted several investigations of wheel assemblies that became detached from the vehicle while driving. These studies have included fractographic examination of the bolts, loosening studies, torque versus pre-load calculations, examination of the effect of painted hubs, and Goodman-based fatigue calculations of fatigue life as a function of bolt torque and pre-load.
- Leaf spring failure analysis: Dr. James' Ph.D. thesis involved embrittlement, fracture, and fatigue of leaf-spring steel, and he has done several failure analysis investigations of leaf springs that fractured in service.
- Brake cylinder: Conducted an investigation of a fractured brake cylinder involved in a meter maid traffic accident. The investigation deterjavascript:void(0);mined that the brake cylinder indeed fractured,

resulting in the accident. Improper assembly, just prior to the accident, cracked the cylinder leaving it susceptible to failure.

Sporting Goods

Dr. James has conducted failure and life assessment analyses for both industrial and legal clients. Examples of these investigations are listed below:

- Bicycle fork analyses: Dr. James has conducted several examinations that have involved determining the cause of bicycle fork failures. He has also worked directly with manufacturers to examine potential metallurgical issues involving bicycle forks.
- Seat-post bolts: Conducted multiple failure investigations of broken seat-post bolts.
- Bicycle weld analysis: Assisted a bicycle manufacturer with the evaluation of novel welding materials and methods with metallurgical and mechanical testing.
- In-line skate bolt fatigue analysis: conducted fatigue testing and analysis for an in-line skate manufacturer. Based on results, recommended bolt grade, size, and torque levels to client.
- Skateboard trucks: Conducted analyses of several skateboard truck fractures, including metallography, fractography, and fracture mechanics.

Electronics

Dr. James has conducted failure analysis investigations and life testing for industrial and legal electronics clients. Representative analyses are listed below:

- Ultrasonic welded ignition module: Conducted a failure analysis investigation of a diesel engine ignition module that had an ultrasonically-welded lead fracture that reportedly resulted in engine stall and an accident. Although severe post-fracture damage was observed, the lead fracture was determined to have been caused by thermal fatigue.
- Capacitor fatigue: Participated in an analysis to determine the cause of capacitor fractures. Fractographic analysis combined with finite element modeling indicated that the capacitors fractured in reverse-bending fatigue due to harmonic oscillation during service.
- Cables and strain reliefs: Dr. James has conducted several strain-relief failure analysis investigations for both electronics and medical device manufacturers. He has also conducted several fatigue life analyses, including testing, to assess and predict cable strain-relief fatigue performance.

Editorships & Editorial Review Boards

Journal of Failure Analysis and Prevention

Peer Reviewer

ASM Handbook, Volume 19, Fatigue and Fracture

Journal of Failure Analysis and Prevention

Biomaterials

Materials Engineering and Performance

Acta Biomaterialia

Appendix B

Recent Deposition and Trial History for Dr. Brad James

Deposition and Trial Testimony: Prior Four Years

Brad James, Ph.D., P.E., FASM

Depositions

1. *Forsta AP-Fonden and Danske Invest Management v. St. Jude Medical*, et al, United States District Court, District of Minnesota, Civil No. 12-3070, April 29, 2016

2. *Parks v. Wright Medical Technology*, Superior Court of the State of California, County of Los Angeles, Case No. BC552067, May 24, 2016

3. *Kury v. The Roman Catholic Archbishop of San Francisco*, Superior Court of the State of California, County of San Francisco, Case No. CGC-14-537606, May 26, 2016.

4. *Summerwinds Garden Centers of CA v. Pacific Gas and Electric Company,* Superior Court of the State of California, County of Santa Clara, Case No. 114CV268757, July 6, 2016

5. *Tucker v. Wright Medical Technology,* United States District Court, Northern District of CA, San Francisco Division, Case No. 3:15-CV-03930-HSG, October 21, 2016.

6. *Parks v. Wright Medical Technology*, Superior Court of the State of California, County of Los Angeles, Case No. BC552067, November 8, 2016.

7. *American Orthodontics Corporation v. Dentsply International*, Case IPR 2016-01652, August 3, 2017.

8. *Hubbard v. Gates et al,* Case No.: 34-2014-00167568, Superior Court of California, County of Sacramento, December 12, 2017.

9. *Southern California Gas Company v. Botts Land Service*, Case No. 15CVP-0080, Superior Court for the State of California, County of San Luis Obispo, February 13, 2018.

10. *Tabletop Media LLC vs. Citizen Systems of America Corporation*, Case No. 2:16-cv-07140-PSG, United States District Court Central District of California, Western Division, August 24, 2018.

11. *Tabletop Media LLC vs. Citizen Systems of America Corporation*, Case No. 2:16-cv-07140-PSG, United States District Court Central District of California, Western Division, September 10, 2018.

12. *Pohlod v. Wright Medical Technology*, District Court Douglas County, CO, Case No. 2014CV099, December 11, 2018.

13. *Boltex Manufacturing Company and Weldbend Corporation v. Ulma Forja,* United States District Curto Southern District of Texas Houston Division, Case No. 4:17-cv-01400, December 20, 2018.

14. *Bradshaw v. Wright Medical Technology,* United States District Court, District of Utah, Case No. 1:16-CV-00108-RJS, May 2, 2019.

15. *Southern California Regional Rail Authority v. Hyundai Rotem Company*, United States District Court, Central District of California, Case No. 16-cv-08042-JAK, July 26, 2019.

Trials

1. *Chevron Pipe Line Company v. Rocky Mountain Power*, United States District Court, Utah, Central Division, Case No. 2:12-CV-00287, September 19, 2017.

2. *Tabletop Media LLC vs. Citizen Systems of America Corporation*, Case No. 2:16-cv-07140-PSG, United States District Court Central District of California, Western Division, October 24 and 25, 2019.

Appendix C

Documents Considered

Appendix C: Documents Considered

BUONO-001692 – 001696 – Wallkill Police Report

BUONO-001697 – 1712 – OHSA Citation

BUONO-001713 – 1714

BUONO-001715 – 1722 – OHSA Statements

BUONO-001723 – 1868 - OSHA File on Oprandys

BUONO-001669 – 1672

BUONO-001673 – 1691

115414-01(286333) - Investigations - Investigation - DocID 8228976 (including U.S. Department of Labor -OSHA Report: Inspection Number 1125359)

115414-01(286333) - Investigations - Investigation - DocID 8229165

Color Photographs of Scene from 02_12_16 _Taken by NY State Police_ (1 of 2)

Color Photographs of Scene from 02_12_16 _Taken by NY State Police_ (2 of 2)

U.S. Department of Labor -OSHA Report: Inspection Number 1125359

Deposition of Franklin Buono

TFP-280809-000001 – 60

TFP-280809-000061 – 113

TFP-280809-001120 – 1121

TFP-280809-001122 – 1340

TFP-280809-001341 – 1345

TFP-280809-001346 – 1358

TFP-280809-001359 – 1370

Poseidon Website

R. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*. 4th Edition, 1995